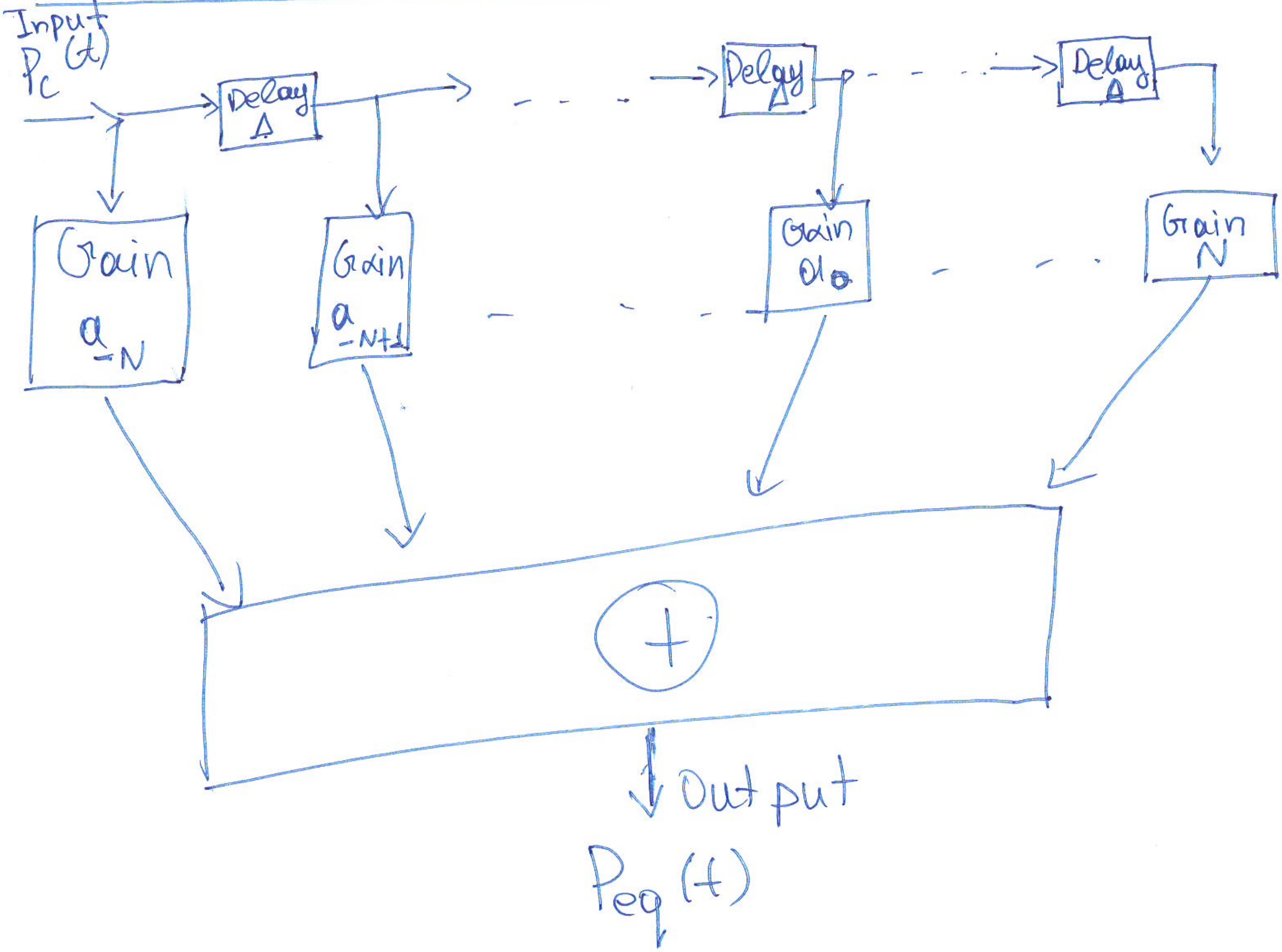
Zero-forcing Equalization

11/18/2019 (1)



$$P_{eq}(t) = \sum_{n=-N}^{N} a_n \cdot P_c(t - n\overset{T}{\cancel{\Delta}})$$

t=0

Nyquist Theorem

$$P_{eq}(mT) = \sum_{n=-N}^{N} a_n P_c\left[(m-n)T\right] = \begin{cases} 1 & , m=0 \\ 0 & , m\neq 0 \end{cases}$$

$$[P_{eq}] = \begin{bmatrix} \left.\begin{matrix} 0 \\ 0 \\ \vdots \\ 0 \end{matrix}\right\} N \\ 1 \\ \left.\begin{matrix} 0 \\ \vdots \\ 0 \\ 0 \end{matrix}\right\} N \end{bmatrix}$$

Output

$1 \rightarrow t=0$

The output of the system for $t=0$ is forced to be 1.

$$[A] = \begin{bmatrix} a_{-N} \\ a_{-N+1} \\ \vdots \\ a_0 \\ a_1 \\ \vdots \\ a_N \end{bmatrix}$$

$$[P_c] = \begin{bmatrix} P_c(0) & P_c(-T) & \cdots & P_c(-2NT) \\ P_c(T) & P_c(0) & \cdots & P_c((-2N+1)T) \\ \vdots & & \ddots & \vdots \\ P_c(2NT) & \cdots & & P_c(0) \end{bmatrix}$$

$$\underset{\text{desired}}{[P_{eq}]} = \overset{\text{Given}}{[P_c]} \cdot [A]$$

I can design

$$[A] = [P_c]^{-1} \begin{bmatrix} 0 \\ \vdots \\ 1 \\ \vdots \\ 0 \end{bmatrix}$$

Example

$P_c(0) = 1.0$

$P_c(T) = 0.3$

$P_c(2T) = -0.07$

$P_c(-T) = 0.2$

$P_c(-2T) = -0.05$

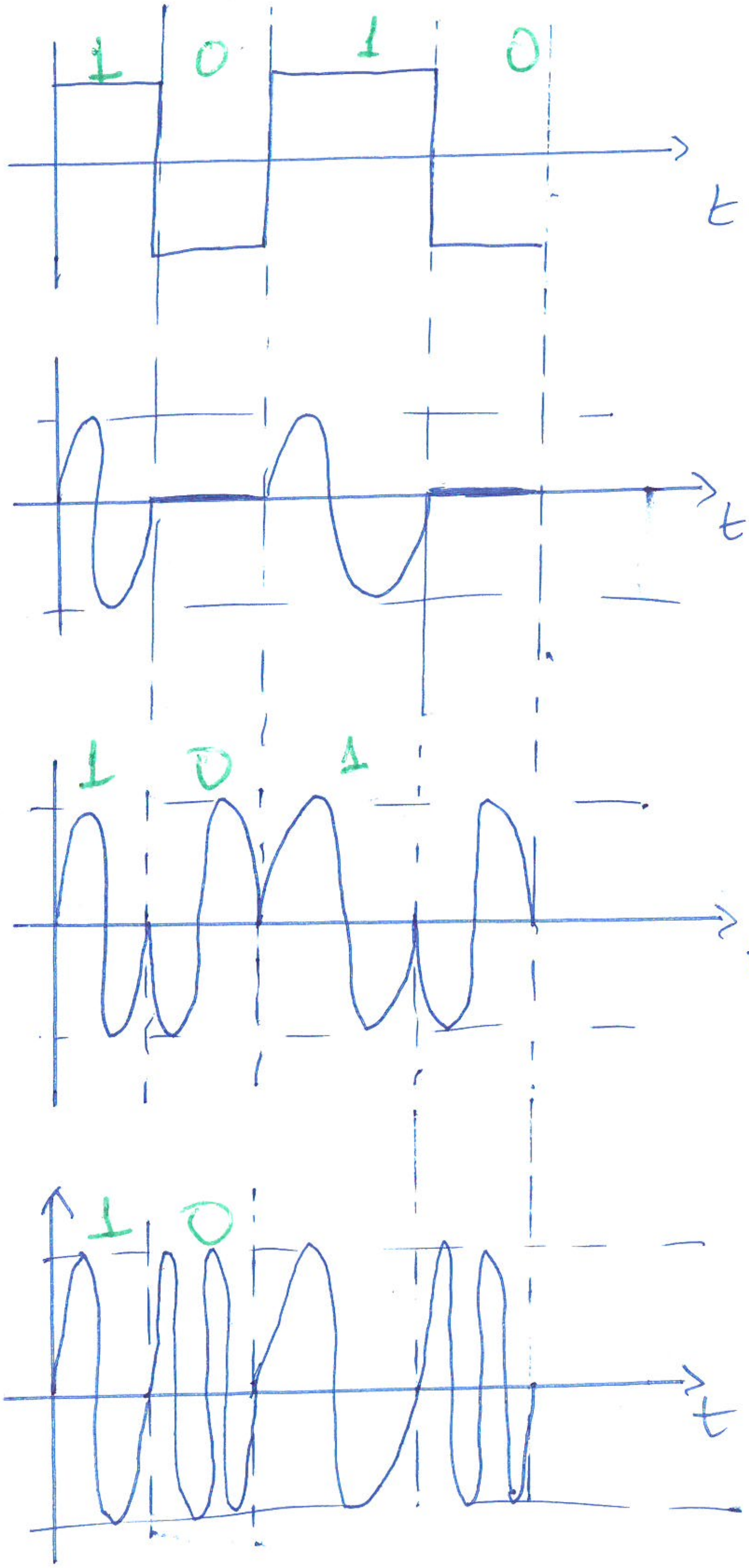
$$[A] = [P_c]^{-1} [P_{eq}]$$

$$[P_c] = \begin{bmatrix} 1.0 & 0.2 & -0.05 \\ 0.3 & 1.0 & 0.2 \\ -0.07 & 0.3 & 1.0 \end{bmatrix}$$

$[P_c]^{-1} = - - -$

$[A] = - - -$

Digital Signals (Modulation)



Amplitude shift Keying (ASK)

$$X_{ASK} = A_c\left[1+d(t)\right]\cos(2\pi f_c t$$

Phase-shift keying (PSK)

$$X_{PSK}(t) = A_c\cos(2\pi f_c t + \frac{\pi}{2} d(t)$$

Frequency-shift keying (FSK)

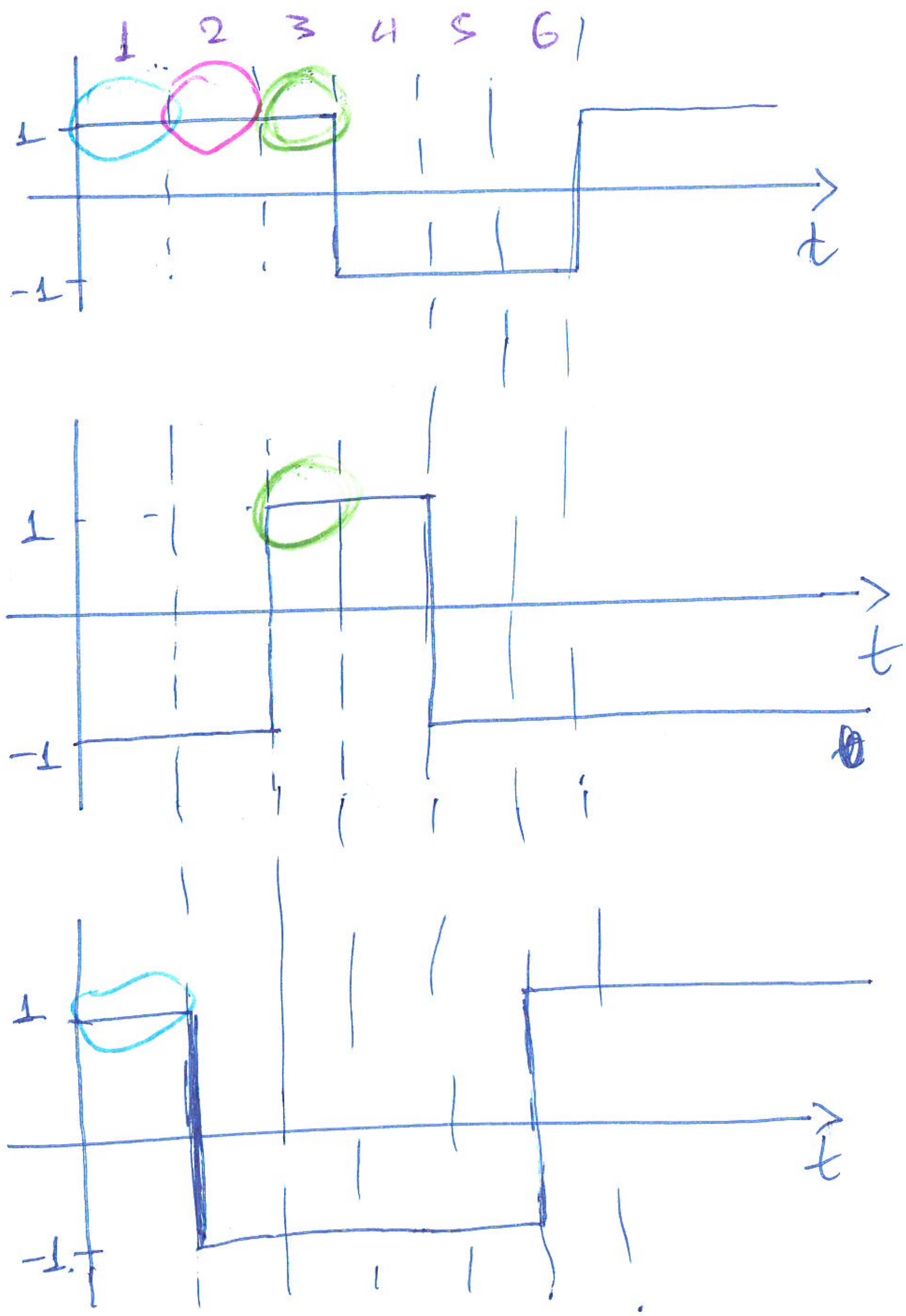
$$X_{FSK}(t) = A_c\cos\left[2\pi f_c t + k_f\int_0^t d(\alpha)\,d$$

Random Waveform : $X(t, \mathcal{J}_i)$

to represent.

member of the sample space.

signal generators



Time Interval: $(0,1)$ | $(1,2)$ | $(2,3)$

Relative Frequency: $\frac{2}{3}$ | $\frac{1}{3}$ | $\frac{2}{3}$

$\frac{\text{number of "ones"}}{\text{total number of samples}}$

$X(t, \zeta_i)$: sample function

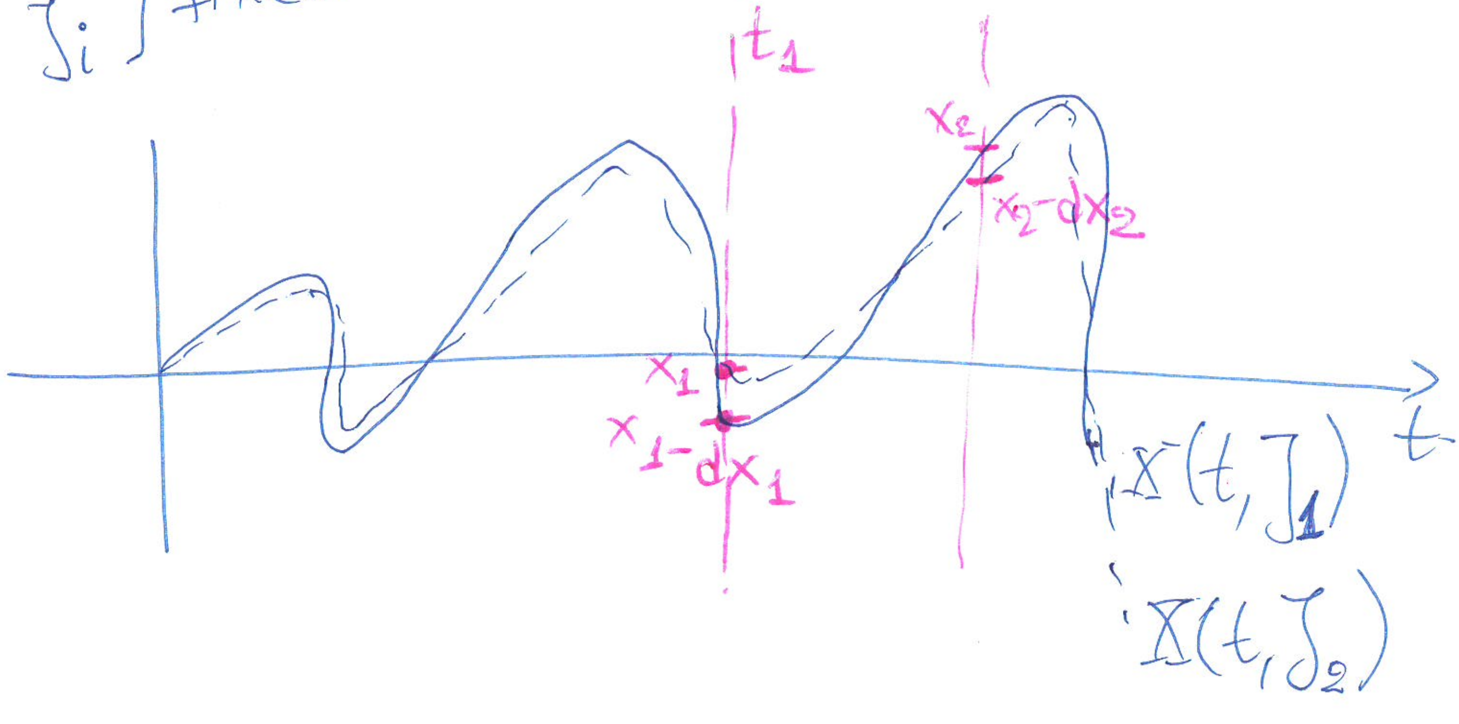
Sample Space : S ← multiple sample functions

Total number of sample functions : ensemb

Underlying experiment : $\boxed{\text{random / stochastic process}}$

$X(t, \zeta_i)$: function of time. (fixed)

$\left.\begin{matrix} t_i \\ \zeta_i \end{matrix}\right\}$ fixed : $X(t, \zeta_i) \xrightarrow{\text{output}}$ number.



$\underline{N=1}$ (one sample function $X(t, \zeta_1)$).

$$f_{X_1}(x_1, t_1)dx_1 = P(x_1 - dx_1 < X_1 \leq x_1, t_1)$$

$\underline{N=2}$ (2 sample functions $X(t, \zeta_1), X(t, \zeta_2)$)

$$f_{X_1 X_2}(x_1, t_1; x_2, t_2) = P(x_1 - dx_1 < X_1 \leq x_1, t_1; \; x_2 - dx_2 < X_2 \leq x_2, t_2)$$